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REQ. NO. 0-9019

July 8, 1980

CONTRACT REPORT NO. OSQ 80-00035

J. Skeaff
Mineral Science Laboratories
Department of Energy Mines and Resources
CANMET, 555 Booth Street
Ottawa, Ontario
K1A 0G1

Dear Jim:

I have enclosed a copy of all work completed to date on DSS file number 17SQ. 23440-0-9019, "Bench-Scale Evaluation of the Dewatering Characteristics of Ra/Ba S04 Sludges."

The remainder of the characterization work will begin in mid August and continue until completion.

Please contact me if you require any additional information.

Yours truly,

CANVIRO CONSULTANTS LTD.

Jeffrey Pike, Senior Technologist

154 pp

Enclosure

/kg

MICROMEDIA
DEC 22 1983

June 3, 1980.

Characterization of BaRaSO4 sludge

Sludge No. 1 - Filter backwash (diluted)
phys. chem. P.P. - from backwashed sand filter also for chem.

1) Suspended Solids

Sample Ident	Final wgt (gms)	Initial Wgt (gms)	Volume (mls)	TSS (mg/l)	AVERAGE (mg/l)
[illegible]	1.2953	0.0703	[illegible]	122500	120,750
[illegible]	[illegible]	0.0700	[illegible]	121080	
[illegible]	[illegible]	0.0710	[illegible]	119880	

2) Total Solids

Sample Ident	Tare + dry solid (gms)	Tare (gms)	Volume (mls)	T.S.	AVERAGE (mg/l)
[illegible]	[illegible]	1.3557	10.0	124670	123,175
[illegible]	[illegible]	1.3795	10.0	122910	
[illegible]	2.5944	1.3749	10.0	121950	

No 2 is MacLaren sludge for chem anal.
same props as first sample

No. 3 Madawaska sludge poss. for chem. anal.
Dave Averill to arrange for delivery

June 3, 80

3) Total Solid:

Sample Ident	Tare + wet wt (gms)	Tare + dry wt (gms)	Tare (gms)	% Solids	Average
4I	13.1795	2.7112	1.3765	11.3081	11.2784
5I	20.1000	3.4699	1.3735	11.1948	
6I	18.4665	3.3122	1.3754	11.3322	

Capillary Suction Time:

1) 11.9
2) 11.1
3) 11.3

Average: 11.4 sec

Density of Suspension

June 3, 1980

BOTTLE IDENT.	TARE (gms)	TARE + DISTILLED (gms)	TARE + SLUDGE (gms)
48	263.27	560.94	588.50
152	260.93	562.19	590.25
195	258.09	559.68	587.54

Temp. of distilled water 26.0 °C

June 4/80

TOTAL SOLIDS

IDENT	TARE + WET	TARE + DRY	TARE	% SOLIDS	$\bar{x}$
7A	19.5377	3.4079	1.3748	11.1970	11.1950
8A	19.8120	3.4388	1.3704	11.2159	
9A	19.7122	3.4176	1.3683	11.1717	

SUSPENDED SOLIDS

IDENT	TARE + DRY	TARE	VOLUME	% SOLIDS	$\bar{x}$
			100		
7A	1.2551	.0709	100	118720	118,400
8A	1.2500	.0704	100	117960	
9A	1.2544	.0695	100	118510	

Sludge Resistance [partly illegible]

DATE: June 4/80 — 9 cm dia. Whatman #1
CONDITIONING: none — Volume of sludge: ~200 ml
FEED SOLIDS: [illegible] (118,400 mg/l) — Wgt of sludge 216.41 g

CAKE ANALYSIS. IDENT: # 75

TARE	102.51
WET	137.00
DRY	122.56
% SOLIDS	58.1%
THICKNESS	2-4 mm

FILTRATE VISCOSITY [illegible] 100-M1131, t = 590 sec, = 608 sec } 59.9 [illegible]

CONSTANT = centistokes / sec = 0.01527

t (min)	V (ml)				
.2	28	24	150	90	[illegible]
.4	48	26	158	120	[illegible]
.6	64	28	164	150	[illegible]
8	75	30	168	ded [illegible]	
10	88	32	170	got	
12	99	34	173	[illegible]	
14	[illegible]	36	174	-no [illegible]	
16	118	38	174	[illegible]	
18	126	40	175		
20	135	50	176		
22	142	70	176		

15" Hg Specific Resistance

DATE : June 4/8[illegible]
CONDITIONING : NONE
FEED SOLIDS 118,400 mg/l

Grade Whatman #1
Volume of Sludge ~ 200 mls
Wgt of Sludge 215.34 gms

CAKE ANALYSIS IDENT : # B12

TARE 110.08
WET 144.32
DRY 130.89
% SOLIDS 60.78 %
THICKNESS 2-3.5 mm

Filtrate Viscosity [illegible] t = 60.5 sec, 59.4 sec } 60.0

t (min)	V (ml)	t (min)	V (ml)	
.2	30	2.0	158	no pressure
.3	46	2.2	168	drop.
.45	60	2.4	172	did not
.60	73	2.6	175	get
.75	8[illegible]	2.8	178	leaks
.90	9[illegible]	3.0	179	
1.1	[illegible]	[illegible]	18[illegible]	
[illegible]	12[illegible]	[illegible]	18[illegible]	
[illegible]	13[illegible]	[illegible]	18[illegible]	
[illegible]	14[illegible]	[illegible]	18[illegible]	
[illegible]	[illegible]			

22" Hg Specific Resistance

DATE: June 4/80
CONDITIONING: NONE
FEED SOLIDS: 118,400 mg/l

9cm Whatman #1
Volume of sludge ~ 200
Wgt of sludge - 216.31

CAKE ANALYSIS: IDENT 2(B-31) TARE: 109.45
WET: 145.17
DRY: 131.70
% SOLIDS: 62.29
CAKE THICKNESS 3.5 mm

FILTRATE VISCOSITY 100 - M131, t = 59.3 sec, t = 61.3 sec } 60.3

t (min)	V (ml)	t (min)	V (ml)	
.2	31	26	178	
.4	61	30	179	
.5	73	50	179.5	
.7	90	75	179.5	
.9	108	100	179.5	
1.2	130	120	179.5	slight press drop
1.4	145			~1/2" Hg
1.[illegible]	1[illegible]	1[illegible]	179.[illegible]	~0.7" Hg
1.8	16[illegible]	180	180	~0.9" Hg
2.0	17[illegible]	[illegible]	[illegible]	~1" press d.
2.20	17[illegible]			

25" Hg Specific Resistance.

DATE: June 4/80 — 9 cm Whatman #1

CONDITIONING: NONE — Volume of sludge ~200 ml

FEED SOLIDS: 118400 mg/l — Wgt of sludge 216.77 gm

CAKE ANALYSIS: IDENT 6(B-34) TARE 102.43

WET 141.41

DRY 126.09

% SOLIDS 60.70.

CAKE THICKNESS ≈ 3.5 mm.

3 FILTRATE VISCOSITY: NO 100-M131 t = 59.8 sec, t = 58.4 sec } 59.1

t (min)	V (ml)
.2	40
.4	69
.6	91
.75	100
.9	120
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
2.1	[illegible]

Specific Resistance 22"Hg

CONDITIONING: 1 lb/ton

9cm Whatman #1
Volume of sludge -
Wt of sludge - 222

FEED SOLIDS: 118,400 mg/l

CAKE ANALYSIS: IDENT: 8(B-35) TARE 102.47
WET 141.82
DRY 124.91
% SOLIDS 57.02
CAKE THICKNESS - irregular

Filtrate Viscosity - no ICC-M131 t=58.3 sec, t=58.1 sec } 58

t(min)	V(ml)	
.35	32	
.5	42	
.75	52	
1.0	[illegible]	
1.[illegible]	[illegible]	
1.7	[illegible]	
2.[illegible]	[illegible]	
2.2	131	
2.5	[illegible]	
2.7	152	
3.[illegible]	16[illegible]	
3.2	172	
3.5	178	
3.60	179	breakthrough

o.ml

Polymer - Aquafloc PE 5/30 (replaces social aquafloc 465)

CONCENTRATION: 0.4 g/400 mls (0.1%)

CALCULATION:

$$\frac{1\ lb}{ton} \times \frac{454\ gms}{lb} \times \frac{1000\ mls}{gm} \times \frac{1\ ton}{2000\ lbs} \times \frac{1\ lb}{454\ gm} \times \frac{118,400\ gms}{l\ of\ sludge}$$

=

∴ 1 lb/ton = 59.2 mls of 0.1% stock / l of sludge
= 11.8 mls/200 mls of sample
2.5 lbs/ton = 148 mls of 0.1% stock / l of sludge
= 29.6 mls/200 mls of sample
5.0 lbs/ton = 296 mls of 0.1% stock / l of sludge
= 59.2 mls/200 mls of sample

NOTE: 1 lb/ton only polymer was attempted, a) because of [illegible] when polymer was added at a conc. of 1 lb/ton a "mass" of solid formed which [illegible] sample [illegible]. Supernatant was [illegible] but supernatant became turbid [illegible] stayed in suspension [illegible]
- cake was [illegible] not [illegible]

8" Hg Specific Resistance

Wgt of sludge + cylinder	461.06	gm
Wgt of cylinder	244.65	gm
Wgt of sludge	216.41	gm

15" Hg Specific Resistance

Wgt of sludge + cylinder	459.62	gm
Wgt of cylinder	244.28	gm
Wgt of sludge	215.34	gm

22" Hg Specific Resistance

Wgt of sludge + cylinder	460.75	gm
Wgt of cylinder	244.44	gm
Wgt of sludge	216.31	gm

25" Hg Specific Resistance

Wgt of sludge + cylinder	461.41	gm
Wgt of cylinder	244.64	gm
Wgt of sludge	216.77	gm

22" Hg + 1.0 lb/ton Specific Resistance

Wgt of sludge + cylinder: 469.08 gms
Wgt of cylinder: 246.78 gms
Wgt of sludge: 222.3 gms

22" Hg + 2.5 lb/ton Specific Resistance

Wgt of sludge + cylinder: gms
Wgt of cylinder: gms
Wgt of sludge: gms

22" Hg + 5.0 lb/ton Specific Resistance

Wgt of sludge + cylinder:
Wgt of cylinder:
Wgt of sludge:

[illegible] Solids

Suspended Solids

IDENT	TARE + DRY	TARE	VOLUME	TSS	$\bar{x}$
10	1.2668	0.0715	10.0	118930	118,300 mg/l
11	1.2481	0.0709	"	117720	
12	1.2525	0.0700	"	118250	

Total Solids

IDENT	TARE + WET	TARE + DRY	TARE	% S	$\bar{x}$
10A	16.2065	3.0736	1.3751	11.4520	
11A	16.1888	3.0829	1.3732	11.5398	11.47[illegible]
12A	16.3220	3.0400	1.3820	11.4323	

Gravity thickening

Initial conc 1, 3, 5, 7, 9%

Suspended Solids - 118,300 mg/l

To get __ % solids final, dilute	y mls to 1000 mls with sludge filtrate *
9	761
7	592
5	423
3	254
1	84.5

* 9% requires $\frac{9\%}{11.83\%} \times 1000$

750

CHECK

761 ml × 118,300 mg/l diluted to 1000 mls

= 90,026 = 90 mg/ml = 90 g/l = 9 g/100 ml
= 9% ✓

Thickening [illegible]

HOURS	MINUTES	CONCENTRATIONS 9%	7%	5%	3%	1%
	1.5	970 X	950 X	930 *	910 *	⊕ [illegible]
	5.0	852	795	715 *	~620 *	~[illegible]
	7.5	782	665	555 *	~400 *	~4[illegible]
	10.0	700	562	400	~155 X	~4[illegible]
	12.5	630	465	296 X	132	3[illegible]
	15.0	583	420	264	118	2[illegible]
	20	523	364	219	99	2[illegible]
1	40	210	151	103	64	~2[illegible]
2	30	180	135	100	64	~2[illegible]
22	30	160	129	97	64	~2[illegible]
25	30	160	129	97	64	~2[illegible]

* interface not very distinct – [illegible] all cloud[illegible]

⊕ interface not distinct, all noticeable floc[illegible] are rapidly settling

⊕ interface at ~ [illegible] minutes after [illegible] [illegible]

distinct interface at X

Suspension remained cloudy for ~1.5 hrs after mixing but the supernatant after 24 hrs was crystal clear.

Leaf Filter –

Initial Solids 1) Total : 11.48 %
2) Suspended : 115,300 mg/l

1) Control

TIME	VOLUME (mls)	TOTAL VOLUME (mls)	
0 sec	0	0	
30 sec	204	204	- see note -
45 sec	48	252	
60 sec	29	281	
90 sec	37	318	
120 sec	31	349	
150 sec	18	367	
300 sec	21	388	
15 min (final)	10	398	

FINAL – CAKE HEIGHT 0-1 mm

CAKE SOLIDS

TRIAL	TARE	TARE + WET	TARE + DRY	% SOLIDS
—	not enough cake for analysis.			

Sludge Freeze

Frozen sample

Freezing began at 10:00 AM June 5/80.

Freezer temperature - Initial - −18 °C.

DATE	TIME	TEMP.	
June 5/80	1000	17 °C	
	1005	16 °C	
	1030	9.5 °C	
	1045	6 °C	– sludge settled to below level of thermocouple
	1100	3.4 °C	
	1130	0.6 °C	
	1230 pm	−0.3 °C	
	130 pm	−0.3 °C	
	330 pm	−0.5 °C	
	430 pm	−0.5 °C	
June 6/80	700 am	−15 °C	
6/80	430 pm	−16 °C	

[illegible]

Sample removed from [illegible] at 500pm June 6/80.

Thawing	Time	Temp

de. Cake formation - thawed sludge is poured on the sand at 1200. June 9/80.

Time (min)	Volume	Total Volume	
~3 sec	- immediate flow -		
0.5	103	103	- very high in solids
1.5	105	208	- high in solids
10.0	66	274	* see note.
30.0	80	354	
60.0	80	434	
90.0	10	444	

CAKE SOLIDS

DISH	TARE	TARE + WET	TARE + DRY	% SOLIDS
[illegible]	1.3800	8.8130	5.2017	52.00

Sludge Drain - Notes

1) Control - June 5/80 - Both sludge + liquid portion of sludge pass through the sand without being captured on the sand. Liquid flow began immediately. There was not enough sludge retained on the surface of the sand to do a cake solids.

2) Sample June 9/80 - Sludge occupies ~ 75 mls of 500 ml sample volume. Particles seem very fine + appear slightly lighter in colour than control. - supernatant quite clear prior to mixing + pouring.

* NOTE: after ~30 seconds flow began to slow up as a cake formed on the sand surface. Of the first ~150 ml through, sludge was passed through also. By the 15 minute mark a liquid layer had formed over the sludge layer.

Centrifugation June 5 '8[illegible]

Height of cake 1) 1.7 cm Centrate Volume 1) 44.0
2) 1.7 cm 2) 44.0
3) 1.7 cm (very clear)
4) 1.7 cm slight turbidity
Total solids on Cake no colour

IDENT	TARE + WET	TARE + DRY	TARE	% SOLIDS	$\bar{x}$
14A	10.2772	6.6392	1.3912	59.06	58.80
15A	10.5743	6.7643	1.3862	58.53	

Scrolled Cake

Cake (scroll) solids

IDENT	TARE + WET	TARE + DRY	TARE	% SOLIDS	$\bar{x}$
16A	4.6220	3.1368	1.3817	54.16	52.48
17A	4.1254	2.8270	1.3854	52.61	
18A	3.4233	2.4160	1.3835	50.66	

Suspended Solids

IDENT	TARE + DRY	TARE	VOLUME	SOLIDS	$\bar{x}$
13	.0833	.0695	10.0	1380	1255 mg/l
14	.0812	.0703	10.0	1130	

Centrifugation – [illegible]

Cake was firm and very compact, sintrate had a white precipitate which caused a turbidity.

Scroll did not lift the cake in the very bottom of the tube & instead, it spun around on the cakes surface

June 5 /80 Vacuum Filtration - 22" Hg.

FILTER MEDIA : NY527F
CYCLE TIME : 3 min

FORM TIME : 58 sec
DRY TIME : 40 sec.
FEED SOLIDS (TOTAL) = %

CAKE ANALYSIS :

IDENT : B-31
TARE : 109.85
TARE + WET :
TARE + DRY :
% SOLIDS :

CAKE THICKNESS :
FILTRATE VOLUME :

Filtrate Solids:

Ident	Tare + dry	Tare	Volume	Solids	$\bar{x}$

% Recovery :
Yield :

Nb note: sample passed through filter unrestricted.

Feed Solids. June 6/[illegible]

Suspended Solids:

IDENT	TARE+DRY	TARE	VOLUME	SOLIDS	
17	1.2531	0.0696	10.0	118350	11[illegible]
18	1.2674	0.0694	10.0	119810	
19	1.2703	0.0711	10.0	119920	

Total Solids

IDENT	TARE+WET	TARE+DRY	TARE	% SOLIDS	[illegible]
19A	24.4809	4.0324	1.3886	11.4475	11.43
20A	23.1465	3.8736	1.3839	11.4375	
21A	23.6238	3.9279	1.3864	11.4289	

June 5 /80 Vacuum Filtration - 22" Hg.

FILTER MEDIA : NY527F
CYCLE TIME : 3 min
FORM TIME : 58 sec
DRY TIME : 40 sec.
FEED SOLIDS (TOTAL) = %

CAKE ANALYSIS :

IDENT : B-31
TARE : 109.85
TARE + WET :
TARE + DRY :
% SOLIDS :

CAKE THICKNESS :
FILTRATE VOLUME :

Filtrate Solids :

Ident	Tare + dry	Tare	Volume	Solids	$\bar{x}$

% Recovery :
Yield :

Nb note: sample passed through filter unrestricted.

June 5 /80 Vacuum Filtration 22"Hg.

FILTER MEDIA : POPF 853F
CYCLE TIME : 3 min

FORM TIME : 58 sec
DRY TIME : 40 sec
FEED SOLIDS (TOTAL) - 11.438 %
TSS - 119.360 mg/l

CAKE ANALYSIS :

IDENT :	B-31
TARE :	109.85
TARE + WET :	166.48
TARE + DRY :	143.20
% SOLIDS :	58.89

CAKE THICKNESS : 3 mm
FILTRATE VOLUME : 550 ml

Filtrate Solids.

IDENT	TARE + DRY	TARE	VOLUME	SOLIDS	$\bar{x}$
15	0.2398	0.0711	20	8435	8385 mg/l
16.	0.2357	0.0690	20	8335	

% Recovery :
Yield. :

Note on Vacuum Filtration run with NY 527F.

- upon imersion of the filter leaf in the 1.5 l sample, more than 1/2 the sample (both liquid + sludge) was drawn <u>through</u> the filter cloth. A very thin sludge film was present on the filter but because the form time was terminated within 10 seconds of starting the test, no analysis was done.

It was obvious that the sludge particles freely passed through the filter + resulted in no cake formation.

<u>Note:</u> An attempted repeat failed when the entire 1.5 l was drawn through the filter cloth.

June 6/80 Vacuum Filtration - 22" Hg

FILTER MEDIA : NY 529F
CYCLE TIME : 3 min.

FORM TIME - 58 sec
DRY TIME - 40 sec
FEED SOLIDS (TOTAL) - 11.438%
TSS - 119,360 mg/l

CAKE ANALYSIS :

IDENT :	8 (B-35)
TARE :	102.47
TARE + WET :	187.60
TARE + DRY :	152.49
% SOLIDS :	58.76

CAKE THICKNESS : 4.5 to 5.5 mm
FILTRATE VOLUME : 475 mls.

Filtrate Solids

IDENT	TARE + DRY	TARE	VOLUME	SOLIDS	$\bar{x}$
20	0.2062	.0723	50	2678	2810 mg/l
21	0.2176	.0707	50	2938	

% Recovery :
Yield :

slight cut in filter paper may ... may or may not have allowed solids to pass through.

June 6/80 Vacuum Filtration - 22" Hg

FILTER MEDIA : POPR 859
CYCLE TIME : 3 min

FORM TIME : 58 sec.
DRY TIME : 46 sec.
FEED SOLIDS (TOTAL) - 11.438%
TSS - 119,360 mg/l.

CAKE ANALYSIS :

IDENT : 2(B-31)
TARE : 109.47
TARE + WET : 181.33
TARE + DRY : 151.84
% SOLIDS : 58.9%

CAKE THICKNESS : 4.5 to 5 mm
FILTRATE VOLUME : 870 mls

Filtrate Solids

IDENT	TARE + DRY	TARE	VOLUME	SOLIDS	α
22	0.7365	.0697	10	66,680	67,485 mg/l
23	0.7538	.0709	10	68,290	

% Recovery :
Yield :

Initial 20-30 sec, sludge passed through the filter cloth.

June 6/80 Vacuum Filtration - 22" Hg.

FILTER MEDIA: POPR 851
CYCLE TIME: 3 min

FORM TIME: 58 sec
DRY TIME: 40 sec.
FEED SOLIDS: (TOTAL) 11.438%
TSS 119,360 mg/l

CAKE ANALYSIS

IDENT: B-12
TARE: 110.09
TARE + WET: 193.15
TARE + DRY: 159.00
% SOLIDS: 58.89

FILTRATE VOLUME: 482
CAKE THICKNESS: 45/65 mm

Filtrate Solids

IDENT	TARE + DRY	TARE	VOLUME	SOLIDS	$\bar{x}$
24	.4560	.0707	50	7706	7630
25	.4481	.0705	50	7552	

% Recovery:
Yield:

June 6/80 Vacuum Filtration - 22" Hg

Filter Media : POPR 864   Form Time : 19 sec
CYCLE TIME : 1 min   DRY TIME : 13 sec.

FEED SOLIDS (TOTAL) - 11.438 %
TSS - 119.360 mg/l

CAKE ANALYSIS

IDENT : 75 (B-55)
TARE : 102.51
TARE + WET : 146.89
TARE + DRY : 128.38
% SOLIDS : 58.29

FILTRATE VOLUME : 266 mls
CAKE THICKNESS : 3.5 to 4 mm

Filtrate Solids

IDENT	TARE + DRY	TARE	VOLUME	SOLIDS	$\overline{X}$
26	.4414	.0711	50	7406	7465 mg/l
27	.4465	.0702	50	7526	

% Recovery :
Yield :

June 6/80 Vacuum Filtration - 22" Hg

FILTER MEDIA : POPR 851
CYCLE TIME : 5 min

FORM TIME : 96 sec
DRY TIME : 67 sec
FEED SOLIDS - TOTAL - 11.438%
TSS - 119,360 mg/l

CAKE ANALYSIS

IDENT : B 33
TARE : 103.38
TARE + WET : 211.54
TARE + DRY : 166.96
% SOLIDS : 58.78%

FILTRATE VOLUME : 660 ml
CAKE THICKNESS : 6 to 6.5 mm

Filtrate Solids

IDENT	TARE + DRY	TARE	VOLUME	SOLIDS	$\bar{x}$
28	.3583	.0705	50	5756	5730 mg/l
29	.3563	.0708	50	5710	

% Recovery :
Yield :

June 6/80 Vacuum Filtration

FILTER MEDIA: POPR 835F (REPEAT - NEW CLOTH) FORM TIME: 58 sec
CYCLE TIME: 3 min DRY TIME: 40 sec.
FEED SOLIDS: TOTAL - 9.698
TSS - 103,850

Cake Analysis

Ident: (B-9) 2
Tare: 109.47
Tare + Wet: 175.76
Tare + dry: 148.88
% Solids: 59.45

CAKE THICKNESS: 4-4.5 mm
FILTRATE VOL: 454 ml

Filtrate Solids

Ident	Tare + dry	Tare	Volume	Solids	$\bar{x}$
33	.4743	.0693	50	8100	7940. mg/l
34	.4592	.0701	50	7782	

Solids. June 6/80.

Suspended

Ident	Tare + dry	Tare	Volume	Solids	$\bar{x}$
30	1.0890	.0696	10.0	101,940	
31	1.1337	.0701	10.0	106,360	103,850
32	1.1021	.0696	10.0	103,250	

Total

Ident	Tare + Wet	Tare + dry	Tare	% SOLIDS	$\bar{x}$
22A	23.2720	3.3978	1.3854	9.1947	
23A	27.2262	3.9522	1.3863	9.9300	9.6980
24A	22.8386	3.5230	1.3842	9.9690	

June 6/80 — Vacuum Filtration

FILTER MEDIA: POPR 835F (REPEAT-NEW CLOTH) FORM TIME: 58 sec
CYCLE TIME: 3 min DRY TIME: 40 sec.
FEED SOLIDS: TOTAL - 9.698
TSS - 103,850

Cake Analysis
Ident: (B-9) 2
Tare: 109.47
Tare+Wet: 175.76
Tare+dry: 148.88
% Solids: 59.45

CAKE THICKNESS: 4-4.5 mm
FILTRATE VOL: 454 ml

Filtrate Solids

Ident	Tare+dry	Tare	Volume	Solids	$\bar{x}$
33	.4743	.0693	50	8100	7940. mg/l
34	.4592	.0701	50	7782	

Vacuum Filtration

June 6/80

MEDIA : NY 527F **REPEAT**
CYCLE TIME : 3 min

FORM TIME - 58 sec
DRY TIME : 40 sec
Feed solids (total - 9.698%
TSS - 103,850.

Cake Analysis

Ident : 9(B-15)
Tare : 103.37
Tare + Wet :
Tare + dry :
% Solids :

CAKE THICKNESS :
FILTRATE VOL :

Filtrate Solids

Ident	Tare+dry	Tare	Volume	Solids	x̄
35			10		
36			10		

ENTIRE SLUDGE VOL SUCKED THROUGH FILTER EXCEPT <1 mm CAKE within 15 sec.

June 6/80 — Floc strength: - Vacuum Filter.

FILTER MEDIA : PCPR 851
CONDITIONING : SHEARED
CYCLE TIME : 3 min

FORM TIME : 58 sec
DRY TIME : 40 sec
Feed Solids: Total - 9.698 %
TSS 103,850 mg/l

CAKE ANALYSIS :

IDENT : 9(B-15)
TARE : 103.37
TARE + WET : 173.05
TARE / DRY : 144.31
% SOLIDS : 58.75

CAKE THICKNESS : 3 to 4 mm
FILTRATE VOL : 482

FILTRATE SOLIDS

IDENT	TARE + DRY	TARE	VOLUME	SOLIDS	$\bar{X}$
35	.5174	.0690	50	8968	8960 mg/l
36	.5171	.0695	50	8952	

% RECOVERY :
YIELD :

Floc Strength - Buchner Funnel June 6/80

CONDITIONING : SHEARED

25" Hg - 9cm Whatman #1.
Appr Volume of sludge - 200 mls

Wgt of sludge + graduate	457.86
Wgt of graduate	244.38
Wgt of sludge	213.48

CAKE ANALYSIS

IDENT : 11 (B-22)
TARE : 109.61
TARE + WET : 142.09
TARE + DRY : 122.60
% SOLIDS : 39.99

CAKE THICKNESS : AVER 3 mm
RANGE 1-3
- cake compact + dry
no cracking

Filtrate viscosity no-100-M131 t = — sec
= — sec

t (min)	V (ml)	t/v	t (min)	V (ml)	
.15	18		1.6	169	
.3	51		1.8	176	
.45	72		2.0	179	
.6	89		2.2	180	
.75	103		2.4	180	
.9	116		2.8	180.5	slight pres. drop
1.	125		3.25	181	<1/2" drop.
1.2	140		7.6	~181.5	" "
1.4	154		15.0	~181.5	" "

↑ terminated

Flex strength. June 6/80

CST - before shearing

1) 11.7
2) 11.5
3) 11.6

AVER: 11.6

CST - after shearing

1) 12.7
2) 12.5
3) 11.6
4) 14.1

AVER. : 12.7

Solids. June 7/80

Total Solids

Ident	Tare + Wet	Tare + dry	Tare	% Solids	$\bar{x}$
25A	20.2479	3.1545	1.3833	9.3890	
26A	21.3057	3.2597	1.3818	9.4254	9.4092 %
27A	18.9042	3.0345	1.3852	9.4132	

Suspended Solids

39	1.0383	.0706	10	96770	
40	1.0141	.0706	10	94350	94830 mg/l
41	1.0045	.0708	10	93370	

June 7 /80 Pressure filter

FILTER MEDIA : PAPR 851
PRESSURE : 50 PSIG

FILTRATE FLOW

Time	Volume	Total/Vol.
~0.5	100	100
1.0	120	220
1.4	250	350
2.5	100	450
2.8	130	480
3.0	152	502
3.6	210	~~[illegible]~~
4.08	250	600
4.75	58	658
5.0	78	678
5.25	98	698
5.5	117	717
5.75	136	
6.2	172	772
6.5	196	796
6.75	219	819
7.0	234	834
7.26	37	

} very quick hard to read accurately

filtrate after first 100 mls was very clear (crystal clear) until breakthrough.

BREAKTHROUGH

last 3 mills cloudy & tinted.

Filtrate solids - first 100 mls

IDENT	TARE + DRY	TARE	VOLUME	SOLIDS (mg/l)
37	.0968	.0709	100	259

Filtrate solids - remainder

IDENT	TARE + DRY	TARE	VOLUME	SOLIDS (mg/l)
38	.0744	.0697	100	47

Filtrate solids - combined

CAKE SOLIDS

IDENT : 7(B-31)
TARE : 109.83
TARE + WET : 262.07
TARE + DRY : 203.51
% SOLIDS : 61.53
CAKE THICKNESS : 18 mm

NOTE: 1) Cake very dry throughout uniform thickness, came out of unit as a brick (easily removed)
2) > 150 mls filtered through while I tried to adj pressure, first 1.5 min flows are approximate.

June 7/80 Pressure filter

FILTER MEDIA: PBPR 851
PRESSURE : 75 PSIG

TIME	VOLUME	TOTAL VOL	
<.5	100	100	+ cloudy turbid
.5	136	236	very slight turbidity
.6	168	268	
.8	220	320	
.99	250	350	
1.49	100	450	
1.6	125	475	
1.75	148	498	
2.0	192	542	
2.25	220	570	
2.49	250	600	
3.15	80	680	
3.5	118	718	
4.25	196	796	
4.5	225	825	
4.78	250	850	
4.99	60	910	- very turbid + high in solids at breakthrough.

Filtrate solids - first 100 mls

IDENT	TARE+DRY	TARE+	VOLUME	SOLIDS mg/l
42	.1608	.0697	100	911

Filtrate solids - remainder.

43	.0786	.0703	100	83

CAKE SOLIDS

IDENT : 6 (B-34)
TARE : 102.43
TARE + WET : 247.85
TARE + DRY : 195.41
% SOLIDS : 63.94
THICKNESS : 18 mm (16 at edges)

· cake very dry, crumbled when removed from pressure filter - ½ cake fell out of filter.

June 7/80 Pressure filter

FILTER MEDIA: POPR 851
PRESSURE: 80 psig – max pressure achievable on regulator is 80 psig

FILTRATE FLOW

Time	Volume	Total Volume
INITIAL	30	30
< .3	100	100
.4	80	180
.7	180	280
1.0	290	350
1.5	90	440
2.0	172	522
2.58	250	600
3.56	96	696
4.50	220	820
4.6	250	850
4.65	10	860

(first entries) slight turbidity

(remaining entries) crystal clear

finish → last 10 mls very cloudy & turbid.

Filtrate Solids - first 100 mls

Ident	TARE + DRY	TARE	VOLUME	SOLIDS mg/l
44	.1311	.0710	100	601

Remainder.

45	.0819	.0700	100	119

CAKE SOLIDS

IDENT: 11(B-22)
TARE: 109.61
TARE + WET: 254.21
TARE + DRY: 201.94
% SOLIDS: 63.85
THICKNESS: estimate 18 mm - cake crumbelled when removed.

June 7/80 Pressure filter

FILTER MEDIA : POPR 855F
PRESSURE : 75 psig

Filtrate flow

Time	Volume	Total Volume	
0	34	34	turbid
< .2	100	100	
.4	100	200	slightly turbid + cloudy
.96	250	350	
1.5	106	456	crystal clear
2.0	186	534	
2.48	250	600	
3.25	8	690	
4.0	172	772	
4.71	253	850	
4.76	44	894	BREAKTHROUGH very cloudy + turbid

Filtrate solids - first 100 mls.

Ident	tare + dry	tare	volume	% solids (mg/l)
46	.1772	.0702	100	1070

Remainder.

Ident	tare + dry	tare	volume	% solids (mg/l)
47	.1877	.0712	250	365

Cake Solids:

IDENT : 9 (B-15)
TARE : 103.38
TARE + WET : 249.54
TARE + DRY : 194.97
% SOLIDS : 62.66
THICKNESS : 18 to 18.5 cm

- cake not as dry as previous runs
did not crumble.

FILTER MEDIA: POPR 859
PRESSURE : 75 psig

Filtrate flow

Time Volume Total Volume

entire volume passed through cloth in less than 45 sec of pressure application as pres was increased. flow pushed right through some cake on cloth (less than 0.5 mm) did not restrict flow.

Filtrate solids - first 100 mls

Ident	Tare+dry	Tare	Volume	% SOLIDS.
59	0.2004	.0703	100	1301

remainder

60	0.0899	.0709	500	38

Cake Solids

IDENT : B-33
TARE : 103.41
TARE + WET : ?
TARE + DRY : 226.68
% SOLIDS : ~62
THICKNESS : 18 to 18.5 mm -

June 9, 86

FILTER MEDIA: NY5291
PRESSURE : 75 psig — new feed solids

Filtrate flow

Time	Volume	Total Volume	
0	2.6	26	
.26	100	100	— very turbid
.8	166	266	turbid, end of first 100 mls
1.2	242	242	
1-26	250	350	
2.0	100	450	crystal clear
2.5	159	509	
3.43	250	600	
4.5	83	683	
5.0	134	734	
5.5	170	770	
6.0	205	805	
6.5	241	841	
—	250	850	
6.8	35	885	slightly turbid

FILTER MEDIA : NY 527F
PRESSURE : 75 psig

Filtrate flow

Time Volume Total Volume

Will not be attempted - cleanup after PPR 859 took 2.5 hrs.

June 9/80.

FILTER MEDIA: CANVAS
PRESSURE = 75 psig

Filtrate flow

Time	Volume	Total Volume	
0	0	0	
·26	100	100	- slightly cloudy
·50	74	174	
·75	132	232	
1·00	182	282	
1·44	250	350	
2·15	90	440	
2·	133	483	
3·0	184	534	
3·5	230	580	
3.75	250	600	
4.25	44	644	
4.6	64	664	
5.0	102	702	
5.5	138	738	
6.0	174	774	
6.5	209	809	
7.0	250	850	
7.04	30	880	← only very slight turbidity at break through. - similar to first 100 mls

Filtrate flow - first 100 mls

IDENT	TARE + DRY	TARE	VOLUME	SOLIDS (mg/l)
56	.0811	.0695	100	116

Remainder

57	.0728	.0704	500	4.8

CAKE SOLIDS

IDENT : 2(B-6)
TARE : 109.47
TARE + WET : 305.29
TARE + DRY : 231.05
% SOLIDS : 62.09
THICKNESS : 18 mm

3

Solids June 9, 80

Total

IDENT	TARE + WET	TARE + DRY	TARE	% SOLIDS	$\bar{x}$
28A	25.4030	4.2350	1.3877	11.8562	11.8820 mg/l
29A	23.5790	4.0117	1.3792	11.8582	
30A	22.0267	3.8454	1.3824	11.9307	

Suspended Solids

IDENT	TARE + DRY	TARE	VOLUME	$\bar{x}$ SOLIDS	
48	1.3341	.0720	10.0	126,210	116,840 mg/l
49	1.0825	.0710	10.0	101,150	
50	1.3032	.0716	10.0	123,160	

Notes on Filter Backwash Sludge

Sludge Appearance – this sludge seems to consist of many uniformly sized particles which mix well but which are very dense & settle out rapidly. The sludge is a light tan ~~in~~ colour and is easily filtered.

Solids analysis were relatively consistent ~~throughout the testing~~.

The initial sludge sample occupied a volume of approximately 2 gallons in the bottom of a clarifier. When washed out and allowed to settle, the solids in the settled sludge were in excess of 40%. A 10% working sample was then made up by dilution.

Pond Sludge from MacFarlane Ponds.

June 9/80

Characterization of BaRaSO4 sludges

Sludge No. 2 - Pond Sludges.

1) Suspended Solids:

Sample Ident	Final wgt (gms)	Initial Wgt (gms)	Volume (mls)	Solids mg/l	$\bar{x}$
61	.3896	.0724	5.0	63440	62,810
62	.3776	.0708	5.0	61,360	
63	.3893	.0711	5.0	63640	

Total Solids

Sample Ident	Tare + dry solids (gms)	Tare (gms)	Volume (mls)	T.S.	$\bar{x}$ mg/l
31A	2.0430	1.3760	10.0	66700	66920
32A	2.0389	1.3715	10.0	66740	
33A	2.0496	1.3765	10.0	67310	

3) Total Solids.

Sample Ident	Tare + wet wgt (gms)	Tare + dry wgt (gms)	Tare (gms)	% SOLIDS	$\bar{X}$
34A	19.8735	2.5670	1.3793	6.4220	6.4620 %
35A	19.6912	2.5631	1.3795	6.4636	
36A	19.9236	2.5855	1.3801	6.5004	

Capillary Suction Time.

1) 70.1
2) 71.5
3) 80.0
4) 75.4

AVER: 74.3 sec.

Density of Suspension

Bottle IDENT	TARE (gms)	TARE + DISTILLED (gms)	TARE + SLUDGE (gms)
48	263.34	561.59	575.82
172	256.92	559.32	573.67
193	262.16	563.95	578.45

Temperature of distilled water . 15.5°C .

Solids

June 10/80.

Total Solids

Ident	Tare + wet (gms)	Tare + dry (gms)	Tare (gms)	% Solids	$\bar{x}$
38A	20.3714	2.5415	1.3745	6.4063	6.4660%
39A	19.9470	2.5818	1.3765	6.4904	
40A	20.8005	2.6536	1.3918	6.5012	

Suspended Solids

Ident	~~Tare + wet~~ (gms)	Tare (gms)	Volume (mls)	Solids (mg/l)	$\bar{x}$ (mg/l)
64	.3870	.0701	5	63,380	62,410.
65	.3763	.0709	5	61,080	
66	.3848	.0709	5	62,780	

8" Hg Specific Resistance.

Date – June 10/80
Conditioning : None
Feed Solids : 62,410 mg/l

9 cm dia. Whatman #1
Volume of sludge ~200 mls
Wgt. of sludge ; 203.25 gms

<u>Cake Analysis</u>: Ident 11 (B-22) Tare : 109.62
Wet : 169.18
Dry : 121.76
% Solids : 20.38
Thickness : 7 to 8 mm.

Filtrate Viscosity (no 100-M131) t = 70.2 sec, t = 69.0 sec } 69.6 sec

time (min)	volume (ml)
0.5	10
1.0	14
2.5	24
5.0	35
10.0	51
15.0	63
20.0	73
25.0	82
30.0	91
40.0	106
50.0	118
60.0	129

time (min)	volume (mls)
70.0	138
72.11	140

1" Hg drop

15" Hg Specific Resistance.

Date - June 10/80
Conditioning: None
Feed Solids : 62,410 mg/l

9 cm dia - W.hatman #1
Volume of sludge ~200 gms.
Wgt of Sludge 204.88 gms

Cake Analysis; Ident : 2(B-31)

Tare : 109.45
Wet : 167.50
Dry : 121.80
% Solids : 21.27
Thickness : 7 to 8 mm

Filtrate Viscosity (100 - M131) t = 68.8 sec ; t = 69.8 sec } 69.3 sec.

time (min)	volume (ml)
0.5	10
1.0	16
2.5	27
5.0	40
10.0	58
15.0	72
20.0	84
25.0	95
30.0	104
40.0	122
50.0	136
55.53	144

↑ 1 inch drop.

22" Hg Specific Resistance

Date - June 10/80 — 9cm Whatman #1
Conditioning - None — Volume of sludge ~200 mls
Feed Solids : 62,410 mg/l — Wgt. of sludge 206.14 gms

Cake Analysis : Ident: B-12
Tare : 110.11
Wet : 163.65
Dry : 122.41
% Solids : 22.97
Thickness : 0.65 to 0.8 cm

Filtrate Viscosity (no 100-M131) t = 66.7 sec, t = 65.6 sec } 66.1 sec

time (min)	volume (mls)		
0.1	flow begins	48.10	149
0.5	11.5		1" pen deep
1.0	17		
2.5	30		
7.5	55		
10.0	64		
20.0	94		
25.0	106		
30.0	117		
35.0	127		
40.0	136		
45.0	144		

25" Hg Specific Resistance.

Date: June 10/80 9 cm Whatman #1
Conditioning: None Volume of sludge ~200 mls
Feed Solids: 62410 mg/l Wgt. of sludge 205.05 gms.

Cake Analysis: Ident: δ(B-35)

Tare: 102.47
Wet: 157.12
Dry: 114.82
% Solids: 22.59
Thickness: 7 to 8 mm.

Filtrate Viscosity (no 100-M131) t= 63.8 sec, t= 65.7 sec } 64.8 sec

time (min)	vol (ml)		
0.08	first flow	43.27	148
0.5	12	1" pres drop	
1.0	18		
3.0	34		
5.0	46		
7.5	57		
10.0	67		
17.5	91		
20.0	99		
25.0	110		
30.0	122		
40.0	142		

22" Hg Specific Resistance

Date - June 10/80
Conditioning - 5 lb/ton PE 5/30
Feed solids - Susp (62.41 g/l)

9 cm Whatman
Vol. of sludge - ~200 mls
Wgt of sludge - 205.53

<u>Cake Analysis:</u> Ident: 7(B-31)

Tare: 109.84
Wet: 158.56
Dry: 120.45
% Solids: 22.80
Thickness: 5 to 6.5 mm

Filtrate Viscosity (no 100-M131) t = 63.1 sec, t = 64.1 sec } 63.6 sec

time (min)	volume (mls)
0.5	16
1.0	23.5
2.5	39.
5.0	56.
10.0	84
15.0	101
20.0	118
25.0	132
30.0	144
35.0	154
36.1	156
	1" drop -

- floc formed initially but seemed lost after minimal mixing. reappeared slightly after sitting

22" Hg Specific Resistance.

Date: June 10/80
Conditioning: 2.5 lb/ton PE 5/30
Feed Solids: 62440 mg/l

9cm Whatman no 1
Volume of sludge ~ 200 ml
Wgt of sludge - 204.76

Cake Analysis: Ident: 9(B-15)
Tare: 103.39
Wet: 152.52
Dry: 115.04
% Solids: 23.71
Thickness: 5.5 to 7 mm

Filtrate Viscosity (no 100-M131) t = 64.1 sec, t = 62.5 sec } 63.3

time (min)	vol (mls)	
0	0	
.5	12	
1.0	19	
2.5	33.5	
5.0	48	- No visible sludge change after polymer addition.
10.0	70	
20.0	102	
25.0	115	
30.0	126	
35.0	136.5	
40.0	146	
44.54	153.5	→ cake seems slightly drier & more compact.

1" pres drop.

Date : June 10/80 9 cm Whatman #1
Conditioning .7.5 lb/ton Aquafloc P5/30 Vol. of sludge ~200 ml
Feed solids : 62410 mg/l Weight of sludge - 202.12

Cake Analysis : Ident : 2(B-9) Tare : 109.60
Wet : 158.89
Dry : 119.65
% Solids : 20.38
Thickness : 5 to 6 mm.

Filtrate Viscosity t = 65.1 sec } 64.3 sec
t = 63.4 sec }

time (min)	volume (mls)
.25	15
.5	25
1.00	37.5
2.00	54.0
3.00	66
5.00	86
7.5	106
11.0	125
13.0	133
15.0	140
17.5	147
19.7	152

- definite floc + floc/liquid separation.
- floc granular ~1/16" very light + fluffy.

June 10/80

Polymer - Aquafloc PE 5/30

Concentration - 0.1 % - prepared June 10, AM.

1 lb/ton = 31.21 mls/l =

2.5 lb/ton = 78.01 mls/l = 39 mls/500 mls

5.0 lb/ton = 156.0 mls/l. = 78 mls/500 mls.

7.5 lb/ton - 234.08 mls/l 117.04 mls/500 mls.

10.0 lb/ton - 312.1 mls/l = 156.05 mls/500

Note: polymer is added to 500 mls of sludge & mixed. 200 mls of a sludge & polymer mixture are then used for specific resistance. - a correction is ∴ necessary at higher polymer doses.

June 10/80.

8" Specific Resistance

Wgt of sludge + cylinder	453.15
Wgt of cylinder	249.90
Wgt of sludge.	203.25

15" Specific Resistance

Wgt. of sludge + cylinder	453.83
Wgt of cylinder	248.95
Wgt of sludge	204.88

22" Specific Resistance

Wgt of sludge + cylinder	454.02
Wgt of cylinder	247.88
Wgt of sludge	206.14

25" Specific Resistance

Wgt of sludge + cylinder	453.52
Wgt of cylinder	248.47
Wgt of sludge -	205.05

22" Specific Resistance , 5.0 lb/ton

Wgt of sludge + cylinder	453.34
Wgt of cylinder	247.81
Wgt of sludge	205.53

22" Specific Resistance, 2.5 lb/ton

Wgt of sludge + cylinder	452.81
Wgt of cylinder	248.05
Wgt of sludge	204.76

22" Specific Resistance 7.5 lb/ton

Wgt of sludge + cylinder	450.22
Wgt of cylinder	248.10
Wgt of sludge	202.12

Centrifuge Test June 10/80

Height of Cake 1) 5.6 cm
2) 5.6 "
3) 5.6 "
4) 5.6 " } 5.6cm

Centrate Volume 1) 22.0 mls*
2) 22.5 mls*
* see notes

Total Solids on Cake

IDENT	TARE + WET	TARE + DRY	TARE	% SOLIDS	$\bar{X}$
41A	27.5955	4.2836	1.3914	11.0372	11.68
42A	23.8320	4.1526	1.3866	12.3232	

Scrolled Tubes

Cake (scroll) solids

IDENT	TARE + WET	TARE + DRY	TARE	% SOLIDS	$\bar{X}$
43A	16.8815	2.9161	1.3825	9.8948	9.91
44A	16.3455	2.8535	1.3678	9.9194	

Suspended Solids (after scroll)

IDENT	TARE + DRY	TARE	VOL	SOLIDS	$\bar{X}$ (mg/l)
67	.1324	.0692	5.0	12640	13,410
68	.1408	.0699	5.0	14180	

Centrification Notes.

1) When centrate (clear liquid slight yellow colour) was decanted, 22.0 mls was volume of "centrate" but a very thick layer of yellow watery paste would also have poured out had I allowed it to. Instead this hydroxide floc like layer was included in the total cake solids. Some fine solids were still carried over during decanting.

Solids

June 11/86

Suspended

Ident	Tare + dry	Tare	Volume	Solids	$\bar{x}$
69	.3841	.0695	5.0	62920	62050 mg/l
70	.3837	.0702	5.0	62700	
71	.3726	.0700	5.0	60520	

Total Solids

Ident	Tare + wet	Tare + dry	Tare	% Solids	$\bar{x}$
45A	21.1685	2.6628	1.3860	6.4632	6.4052
46A	21.4493	2.6457	1.3623	6.3891	
47A	20.9257	2.6132	1.3641	6.3724	

Gravity Thickening June 11/80

Initial conc : 1, 3, 5 and as is.

Suspended Solids: 62050 mg/l

To get x% final conc, dilute y mls to 100 mls with pond decant.

1	161.2
3	483.5
5	805.8

$$5\% = \frac{5\% \times 1000}{6.205\% \text{ solids}}$$

Notes

Thickening curves

HOURS	MINUTES	10%	5	3	1	COMMENTS.
0	0	1000	1000	1000	1000	
	2·5	1000	>995	>990	985	1/16 to
	5·0	>995	>990	>990	950*	1/8" clear leg on samples (with <
	15·0	>995	>990	>990	797	
	20·0	>995	>990	990	735	
	30·0	>995	>990	920	456	
	60·0	>995	~990	895	404	
	90·0	995	986	795	335	
	120·0	995	978	724	305	
	180·0	995	965	680	279	
	240·	990	960	650	257	
	530 min	985	920	585	224	
	1440 "	970	840	525	209	

NOTES

* sludge - granular seems like small flocs - supern. slightly cloudy.

Supn. of 1 + 3% was cloudy (slightly) for the first couple of hours but then became clear and colourless.

Freeze Thaw June 11/80

Date: June 11/80
Total Solids: 6.4052 %
Suspended: 62,050 mg/l

I) Control:

	Time	Volume (mls)	Total Volume (mls)	
	0	0	0	
1st drop	– between 45 + 55 minutes.			
1245 June 11	– 2 HRS	23	23	– yellow, clear
1:15	3.5 HRS	28	51	– slightly lighter
5:00	7.25 "	54	105	
9:45	12:00 "	41	146	
(AM) 7:30 June 12		17	163	– clear colourless
11:45 "		~2	165 mls	– clear colourless.

Final cake height – 37 to 43 mm.

Cake Solids

Wt.	Tare + Wet	Tare + dry	Tare	% Solids.
9(B+15)	103.39	19.73	115.18	13.35

Frozen Sample

Freezing began at 930 AM June 11/80

DATE	TIME	TEMP.
June 11/80	9:30	18°C
	10:15	10.4°C
	10:45	6.2°C
	12:00	+0.1°C
	1245	-0.4°C
	4:00	-0.4°C
June 11/80	945 pm	- 7°C
June 12/80	730 am	- 15°C
June 12/80	530 pm	-15°C
June 13/80	730 am	-15°C

'r colour

Sample removed from freezer at 8:30 AM June 13/80.

Thawing — Time Temperature

Time	Date	Temperature
8:30	June 13/80	- 15°C
9:30		-0.1°C
10:15		+0.2°C
11:15		+0.4°C
1:30		+1.9°C
1:45		+4°C
2:15		10°C

June 14 0700 - 24°C
1145 - 28°C

Cake Formation.

- Thawed sludge was poured on the sand at 11:45 on June 14/80.

Time	Volume (ml)	Total Vol.	
0	0	0	
30 sec	279	279	- very cloudy & turbid
60 sec	56	335	- slightly less cloudy
90 sec	12	347	- slight turbidity
3 min	~5	352	

Cake Solids

Ident	Tare + Wet	Tare + dry	Tare	% Solids.
9	142.92	118.32*	103.38	37.78%*

* dry cake is very powdery,

Freeze Thaw - Notes.

After thawing, sludge occupies <100 mls on the bottom of the container.

Supernatant above sludge is clear, (crystal clear,) prior to mixing + pouring.

After pouring, liquid fraction which passed through the sand bed was high in turbidity and had a slight green yellow-tinge.

The cake was like wet sand + was very dense. Most of it remained in the container + had to be scraped onto the bed, even though it was well mixed just prior to pouring. The final sand scraped out formed a "cake". of sand like sludge

Solids

June 12/80

Total Solids

Ident	Tare + wet	Tare + dry	Tare	% Solids	x̄
48A	22.0875	2.7054	1.3677	6.4561	
49A	19.9820	2.5641	1.3692	6.4198	6.4410 %
50A	19.8210	2.5580	1.3684	6.4468	

Suspended Solids

Ident	Tare + dry gms	Tare gms	Volume ml	Solids mg/l	x̄
76	.3806	.0710	5.0	61920	
77	.3835	.0708	5.0	62540	62,490 mg/l
78	.3858	.0708	5.0	63000	

June 11/80 Vacuum Filtration

FILTER MEDIA : NY 529F FORM TIME : 58 sec
CYCLE TIME : 3 min DRY TIME : 40 sec
FEED SOLIDS : (TSS) 62050 mg/l

Cake Analysis

Ident : B-33
Tare : 103.41
Tare + Wet : 117.49
Tare + Dry : 106.28
% Solids : 20.38

CAKE THICKNESS : 4/5 mm
FILTRATE VOLUME : 63 mls

Filtrate Solids

Ident	Tare + dry	Tare	Volume	Solids	$\bar{x}$ (mg/l)
72	.0998	.0705	10.0	2930	2920
73	.0992	.0701	10.0	2910	

% Recovery :
Yield :

Cake was very "pasty" & was difficult to scrape off the cloth.

Vacuum Filtration June 11/80

FILTER MEDIA : NY 527F FORM TIME : 58 sec.
CYCLE TIME : 3 min DRY TIME : 40 sec
FEED SOLIDS : TSS - 62050 mg/l

Cake Analysis

Ident : 6(B-34)
Tare : 102.45
Tare + Wet : 115.60
Tare + Dry : 105.83
% Solids : 25.82

CAKE THICKNESS : 14 to 15 mm
FILTRATE VOLUME : 174

Filtrate Solids

Ident	Tare + Dry	Tare	Volume	Solids	$\bar{x}$ (mg/l)
74	.2739	.0708	5.0	40620	40,280 mg/l
75	.2700	.0703	5.0	39,940	

% Recovery :
Yield :

Filtrate - thick + creamy like a blended milkshake or thick paint -
Cake - small cracks, still had to be scraped from cloth, (pasty).

Polymer Preparation June 11/80

No. 1. 423K - @ 0.1% (0.4g/400 mls)
No. 2. 434K - @ 0.1% "
No 3 435KA - @ 0.1% "
No 4 AQUAFLOC PE5/50 @ 0.1% "
No 5 2810/74 @ 0.1% "
No 6. 2935/74 @ 0.1% "

Note: - Polymers 1,2,3,5+6 have been in the lab for over 6 months.
Percent activity & aging effects may effect individual performance.

June 12/80

Control - no polymer. 1) 62.6 2) 58.6 } 60.6 sec

Polymer 423K - 2.5 lb/ton 1) 40.1 2) 44.6 } 42.4 sec no visible flocs

7.5 lb/ton 1) 2) - formed "lumps", free liquid, very slow settling
2.6 sec

Polymer 435KA - 2.5 lb/ton 1) 46.4 2) 42.4 } 44.4 sec

7.5 lb/ton 1 2 - formed granular floc, free liquid, very slow settling
(5.2 sec)

3) 42.1 Ave = 43.6 sec

June 12/80

Polymer 434K	2.5 lb/ton	1) 42.2 2) 39.1	41.1 sec	
	7.5 lb/ton	1) 2)	granular floc, same as 435K - free liquid slow settling.	
Aquafloc PE 5/30	2.5 lb/ton	1) 50.1 2) 52.7	51.4 sec.	
	7.5 lb/ton	1) 2)	granular flocs, but fluffier than 434 + 435	
Polymer 2810/74	2.5 lb/ton	1) 43.3 2) 44.6	44 sec	
	7.5 lb/ton	1) 2)	larger granular floc, free liquid - slow settling.	
Polymer 2935/74	2.5 lb/ton	1) 48.8 2) 48.9	48.9 sec.	
	7.5 lb/ton	1) 2) 8.1 sec	fine fluffy but granular flocs, no floating free water, little settling.	

Note: solids were not done on the sludge prior to polymer but in as much as all sludge tested came from the same lot, all numbers are relative. For dosing purposes, the average of the three previous days solid were used.

Dosages : 1) average solids 62420 mg/l

2·5 lb/ton = 78·0 ml/l = 15·6 mls/200 mls.

7·5 lb/ton = 234 ml/l = 47 mls/200 mls

(31·2 mls/l/ lb per ton.)

Conclusions

None of the polymers tested were extremely effective at 2·5 lbs/ton but the best were the 400 series.

June 12/80 Vacuum Filtration

Filter Media : PcPR 859 Form time : 58 sec
Cycle time : 3 min . dry time : 40 sec
Feed Solids (TSS) 62490 mg/l

Cake Analysis :

Ident : 2(B-6)
Tare : 109.48
Tare + Wet : 126.01
Tare + dry : 112.58 Thickness : 1.5 to 2 mm
% solids : 18.75 Filtrate Vol. 90 mls

Filtrate Solids

Ident	Tare + dry	Tare	Volume	Solids	$\bar{x}$
79	.2288	.0718	5.0 mls	31400	31270 mg/l
80	.2260	.0703	"	31140	

% Recovery
Yield

June 12/80 Vacuum Filtration

Filter Media : PoPR PoPR853F Form time - 58 sec.
Cycle time : 3 min. dry time - 40 sec.
Feed solids (TSS) 62490 mg/l

Cake Analysis :

Ident : 7(B-31)
Tare : 109.84
Tare+Wet : 124.75
Tare+dry : 113.05 Thickness : 1.5 to 2 mm
% solids : 21.56 Filtrate Volume : 78 mls

Filtrate Solids

Ident	Tare+dry	Tare	Volume	Solids	$\bar{x}$
81	.1072	.0711	5.0	7220	7280 mg/l
82	.1086	.0719	5.0	7340	

% Recovery :
Yield :

June 12/80 Vacuum Filtration

Filter Media: PoPR 851 Form time: 58 sec
Cycle time: 3 min dry time: 40 sec
Feed Solids (TSS) 62490 mg/l

Cake Analysis:

Ident: 8(B-35)
Tare: 102.45
Tare + wet: 116.04
Tare + dry: 105.45 Thickness: 1 to 1.5 mm
% solids: 22.08 Filtrate Vol: ~~1 to 1.5~~ mm 73 mls

Filtrate Solids

Ident	Tare + dry	Tare	Volume	Solids	$\bar{x}$
83	.0976	.0715	5.0	5220	5160 mg/l
84	.0968	.0713	5.0	5100	

% Recovery
Yield.

June 12/80

Filter Media : Popr 851   Formtime : 19 sec
Cycle time : 1 min -   dry time : 13 sec
Feed Solids (TSS) 62490 mg/l

Cake Analysis
Ident : 2(B-31)
Tare : 109.48
Tare + Wet : 120.28
Tare + dry : 111.38   Thickness : 1.5mm
% Solids : 17.59   Filtrate Vol : 39 mls

Filtrate Solids

Ident	Tare + dry	Tare	Volume	Solids	$\bar{x}$
85	.1048	.0714	5.0	6680	6720 mg/l
86	.1044	.0706	5.0	6760	

% Recovery
Yield .

June 12/80 Vacuum Filtration

Filter Media: Popr 851 Form time: 96 sec
Cycle time: 5 min. dry time: 67 sec.
Feed Solids (TSS) 62490 mg/l

Cake Analysis:

Ident: 75 (B-33)
Tare: 102.51
Tare + wet: 122.19
Tare + dry: 106.95 Thickness: 2.5 mm
% solids: 22.56 Filtrate Vol: 102 ml

Filtrate Solids

Ident	Tare + dry	Tare	Volume	Solids	$\bar{x}$
87	.0887	.0715	5.0	3440	3450 mg/l
88	.0876	.0703	5.0	3460	

% Recovery:
Yield:

Solids

June 13/80

Suspended

Ident	Tare+dry	Tare	Volume	Solids	$\bar{x}$
89	.3793	.0702	5.0	61820	
90	.3803	.0720	5.0	61660	61,670 mg/l
91	.3780	.0703	5.0	61540	

Total

Ident	Tare+wet	Tare+dry	Tare	% Solids	$\bar{x}$
51A	21.3690	—	1.3578	—	
52A	21.2515	2.6425	1.3550	6.4710	6.4386%
53A	21.6418	2.6521	1.3623	6.4063	

Polymer dosage

2.5 lb/ton = $\frac{2.5 \times 61.67}{2}$ = 77.09 ml/l = 115.6 mls/1.5 l

5.0 lb/ton = 154.2 mls/l = 231 mls/1.5 l

7.5 lb/ton = 231.3 mls/l = 347 mls/1.5 l

Vacuum Filtration June 13/80

Filter Media : PePR 85 Form time : 58 sec.
Cycle time : 3 min dry time : 40 sec.
Feed Solids (TSS) : 61,670 mg/l Conditioning : 5 lb/ton 434K

Cake Analysis:

Ident : 6(B-34)
Tare : 102.43
Tare + wet : 128.28
Tare + dry : 106.14 Thickness - 2 to 5 mm
% solids : 14.35% Volume - 136 ml

- cake not even - bumpy.

Filtrate Solids

Ident	Tare + dry	Tare	Volume	% Solids	$\overline{x}$
94	.0912	.0721	10.0	1910	1925 mg/l
95	.0904	.0710	10.0	1940	

% Recovery :
Yield :

NOTE : ⊳ 231 mls of 0.1% 434K added to 1500 mls sludge + then 1500 mls of the mixture was used for the filter leaf
- cake seems quite wet.

— Vacuum Filter. June 3/80

Filter Media : BPK
Conditioning : 7.5 lb/ton
Cycle time : 3 min.

Form time : 58 sec.
dry time : 40 sec.
Feed solids (TSS) - 61,670

Cake Analysis

Ident : 6-33
Tare : 103.42
Tare + wet : 157.19
Tare + dry : 110.27
% Solids 12.74

Thickness : 0 to 15 mm
Filtrate Vol : 629 mls *

* liquid being pulled through as no cake was building up.

Filtrate Solids

Ident	Tare + dry	Tare	Volume	% Solids	$\bar{x}$
96	.0775	.0711	50.0	128	127 mls.
97	.0785	.0722	50.0	126	

% Recovery :
Yield. :
NOTE: 347 ml of 0.1% 434 K added to 1500 mls sludge + then 1500 mls of mixture used for filter leaf.

Notes - Filter leaf with polymer. Ju

At 5.0 lb/ton a fine floc (granular) forms but is very slow to settle 1/8" in 250 ml beaker in five minutes.

CST before polymer -
CST after polymer - 14.6
- 16.0
- 23.7
- 25.3
- 22.2

Note: I ran out of CST paper after 2 runs & cut some of the spare sheets. These gave considerably higher times
JB

At 7.5 lb/ton - granular floc & free liquid - floc slow settling (similar to 5.0 lb/ton)

CST <3 sec on 2 tries.

June 13/80. Floc Strength - Vacuum Filtration

Filter Media : POPR 851
Conditioning : sheared
Cycle time : 3 min

Form time : 58 sec
dry time : 40 sec
Feed solids (TSS) - 61670 mg/l

Cake Analysis

Ident : B-12
Tare : 110.10
Tare + wet : 121.35
Tare + dry : 112.86
% solids : 24.53

Thickness : 1.5 mm
Filtrate Vol : 59 mls

Filtrate Solids

Ident	Tare + dry	Tare	Volume	Solids	$\bar{x}$
92	.0956	.0714	5.0	4840	4820 mg/l
93	.0940	.0700	5.0	4800	

% Recovery :
Yield :

June 13/80 Floc strength - Buchner Funnel

Conditioning - sheared

25" Hg - Whalman #1
Appr. vol. of sludge - 200 ml

Wgt of sludge + graduate	452.64	gms
Wgt of graduate	247.80	gms
Wgt of sludge	204.84	gms.

Cake Analysis
Ident: B-22
Tare: 109.64
Tare + wet: 158.20
Tare + dry: 121.64
% Solids 24.71

Cake Thickness: 7 mm

Filtrate Viscosity (100 - M131) t = 62.6, t = 63.6 } 63.1 sec

time (min)	Vol (mls)
.08	first flow
.5	14
1.0	22
1.5	28
2.5	37.5
5.5	57.5
7.5	68
10.0	80
15.0	99
20	115
25	129
30	142
32.5	148
34.78	152

Floc Strength June 13/80

est

1) Before shearing

1) 61.9
2) 64.1
3) 57.0

61.0 sec.

2) after shearing

1) 59.6
2) 59.4
3) 58.3

59.1 sec.

Solids June 14/80

Total

Ident	Tare + wet	Tare + dry	Tare	% Solids	$\bar{x}$.
54A	21.6066	2.6691	1.3650	6.4427	
55A	21.5896	2.6757	1.3635	6.4877	6.4614 %
56A	22.2084	2.7056	1.3601	6.4538	

Suspended

Ident	Tare + dry	Tare	Volume	Solids	$\bar{x}$.
98	.3831	.0698	5.0	62640	
99	.3885	.0705	5.0	63600	62,740 mg/l
100	.3798	.0699	5.0	61980	

June 14/80

Filter Media - POPR 851 Conditioning - None
Pressure - 75 psiG.

Time (min)	Vol (ml)	Total Volume (ml)	
0	0	0	clear liquid
1.0	~~32~~ 26	26	
2.5	44	44	
5.0	66	66	
10.0	96	96	
10.95	100	100	
25.0	52	152	slight green yellow tinge but liquid is not turbid
45.0	109	209	
60.0	141	241	
124	250	350	
180	75	425	
240	143	493	
300	206	556	
346.68	250	600	
360	14	614	
390	44	~~628~~ 644	
420	70	670	
450	94	694	
479.1	123	723	Breakthrough - no great solids carryover.

NOTE: Sample increases in turbidity with time, turns to go yellow white & becomes turbid.

Filtrate Solids - first 100 mls

Ident	Tare+dry	Tare	Volume	$\bar{x}$
101	.0713	.0703	100	10 mg/l.

Remainder.

102	.0719	.0702	250	6.8 mg/l

Cake Solids

Ident: 2(B-31)
Tare: 109.45
Tare+Wet: 346.10
Tare+dry: 168.37
% Solids: 24.90
Thickness: 4.8 cm.

[signature]

June 15/

Filter Media - Type 851
Pressure - 75 psig Conditioning - 5 lb/ton 434

Time (min)	Volume (ml)	Total Volume (ml)
0	10	10
.4	35	35
.8	45	45
1.2	53.5	53.5
1.6	60	60
2.0	67	67
3.0	80.5	80.5
4.65	100.0	100
10.0	44	144
20.0	104	204
30.0	151	251
45.0	[illegible]	[illegible]
67.5	[illegible]	[illegible]
90.0	[illegible]	[illegible]
120.0	[illegible]	[illegible]
150	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
19[illegible]	[illegible]	[illegible]

(0 – 3.0 min) some solids in first 100 mls, but not much

(4.65 – 67.5 min) filtrate clear, [illegible] yellow coloured [illegible] turbidity appeared on standing.

[illegible], not [illegible], [illegible] carry over

Filtrate Solids - first 100 mls

Ident	Tare + dry	Tare	Volume	Solids	$\bar{x}$
103	.0725	.0710	100	15 mg/l	

Remainder

104	.0721	.0704	500	3.4 mg/l.	

Cake Solids

Ident: # 75
Tare: 102.52
Tare + Wet: 413.69
Tare + Dry: 154.21
% Solids:
Thickness:

[illegible] = [illegible] mg/l - add polymer to sludge, flocculate + dilute [illegible] to

C.S.T. – After 5.0 [illegible] polymer

1) 14.4
2) 16.3
3) 15.6

} 15.4 sec.

Initial

1) 62.9
2) 59.9
3) 62.5

} 61.8 sec.

MacLarens Sludge

The MacLarens sludge is a light chocolate brown colour with a oatmeal like consistancy. It seems to be of a more consistant particle size than the previous MacLarens sludge. The largest particles in the sludge are smaller than similar particles in the previous sludge.

The sludge also was thicker than the last batch and seemed more difficult to filter.

A [illegible] sampler took a cross sectional area of the sludge from the surface to the bottom.

Characteristic worms and jellies were not present in this sludge, nor was the hydroxide floc like layer in which the worms lived in the first sludge.

The sludge settled quite slowly and at full concentration, settled very slowly (less than 1" in 2 foot height of sludge in 24 hours.)

Yellow white, green and red particles were again present in the sludge varying in size from less ~~tan~~ than 1 mm to approximately 5 mm. The larger particles did not plug a pipet and were very gelatinous.

Large amounts of grit and pebbles were present in the sample averaging 4 to 5 mm in size with some larger and some smaller.

CANVIRO CONSULTANTS LTD.
178 LOUISA ST., KITCHENER, ONTARIO N2H 5M5 519-579-3500

September 1980

Dr. J.M. Skeaff
Mineral Science Laboratories
Department of Energy, Mines and Resources
CANMET, 555 Booth Street
Ottawa, Ontario
K1A 0G1

Dear Jim:

I have enclosed a copy of the sludge dewatering data which was recently completed on the Ra-Ba sludge from Madawaska.

These results complete DSS contract File Number 17SQ.23440-0-9019, Serial number OSQ80-00035, "Bench Scale Evaluation of the Dewatering Properties of Ba/$RaSO_4$ sludges".

If you have any questions or require any additional information on any of the three sludges, please call Herb Campbell or myself at your convenience.

Yours truly,

CANVIRO CONSULTANTS LTD.

Jeffrey Pike

Enclosures

/kg

Aug 13/80

Characterization of Ba-RaSO4 sludges,

Sludge No. 3 - Madawaska Sludge.

1) Suspended Solids

Sample Ident	Tare + dry	Tare	Volume	Solids	$\bar{x}$
105	.9065	.0706	5.0	167180	167,940.
106	.9121	.0707	"	168280	
107	.9126	.0708	"	168360	

2) Total Solids

Sample Ident	Tare + dry solids (gms)	Tare (gms)	Volume (mls)	T.S. (mg/l)	$\bar{x}$
57A	3.1954	1.3653	10.0	183010	182480
58A	3.1845	1.3663	"	181820	
59A	3.1810	1.3548	"	182620	

Aug 13/80

3) Total Solids

Sample Ident	Tare + wet (gms)	Tare + dry (gms)	Tare	% Solids	$\bar{x}$
60A	22.0235	4.6750	1.3537	16.0684	16.0522 %
61A	21.7185	4.6208	1.3548	16.0383	
62A	23.0125	4.8405	1.3663	16.0499	

Capillary Suction Time (C.S.T).

1) 21.7
2) 22.2
3) 20.6

} 21.5 sec

Aug 13/80.

Density of Suspension

Bottle Ident	Tare (gms)	Tare + distilled (gms)	Tare + Sludge (gms)
48	263.32	561.35	600.51
172	256.93	559.04	598.84
193	262.17	563.65	603.32

Temp. of distilled water 20.2 °C.

Aug 14/80

Total Solids

Ident	Tare + wet	Tare + dry	Tare	% Solids	$\bar{x}$
108 63A	20.0369	4.3555	1.3524	16.0727	16.1056
109 64A	22.5610	4.7749	1.3606	16.1003	
110 65A	22.8775	4.8355	1.3621	16.1439	

Suspended Solids

Ident	Tare + dry	Tare	Volume	Solids	$\bar{x}$
108	.9145	.0706	5.0 ml	168780	169380
109	.9214	.0718	"	169920	
110	.9178	.0706	"	169440	

8" Hg Specific Resistance.

Date: Aug 14/80
Conditioning: none
Feed Solids: TSS 169380

9 cm dia Whatman #1
Volume of sludge ~ 200
Wgt of Sludge 223.48 gms

Cake Analysis: Ident: 75 (B-33)
Tare: 102.53
Wet: 164.08
Dry: 136.73
% Solids: 55.6 Thickness .45 to 5.0 mm.

Filtrate Viscosity no 100 - M131 t = 63.7 sec, t = 63.2 " } 63.5 sec.

CONSTANT = centistokes/sec = 0.01527

t (min)	V (ml)	t (min)	V (ml)
.30	19	6.0	126
.60	31	7.5	143
1.00	44	9.0	156
1.3	52	10.0	159 ~10.08 slight pres drop
1.6	59	11.5	160
2.0	67	12.9	~160.5 - 1" pres. drop
2.5	76		
3.0	85		
3.5	93		
4.5	107		

15" Hg Specific Resistance

Date: Aug 14/80
Conditioning: none
Feed Solids: (TSS) 169380

9 cm dia. Whatman #1
Volume of sludge ~ 202
Wgt of sludge 224.82 gms.

Cake Analysis: Ident: 9(B-15)
Tare: 103.38
Wet: 164.41
Dry: 138.26
% Solids: 57.2 Thickness: ≈ 5.0 mm

Filtrate Viscosity no 100-M131 t = 62.7 sec } 63.1 sec.
t = 63.4 sec }

t(min)	V(ml)	t(min)	V(ml)
.3	24	7.0	158
.6	37	7.5	161.5
1.0	51	7.91	163 ↑ 1" pres drop
1.3	61		
1.6	69		
2.0	79		
2.5	89		
3.0	98		
3.5	108		
4.0	117		
5.5	139		

22" Hg Specific Resistance

Date : Aug 14/80
Conditioning : none
Feed Solids : TSS (169380)

9 cm Whatman #1
Volume of sludge ~ 201 ml
Wgt of sludge - 224.50 gms

Cake Analysis : Ident : 2(B-31)

Tare : 109.46
Tare + Wet : 169.42
Tare + Dry . 144.39
% Solids 58.3
Thickness . 4.5 to 5.0 mm

Filtrate Viscosity (100-M131) t = 63.0 } 63.1
t = 63.2 } sec

t(min)	V(ml)	t(min)	V(ml)
.3	26	5.0	151
.6	42	5.5	159
1.0	57	6.0	163
1.3	68	6.18	164
1.6	78		1" pres. drop
2.0	89		
2.3	96		
2.6	104		
3.0	112		
3.5	123		
4.0	133		
4.5	142		

25" Hg Specific Resistance

Date: Aug 14/80 9 cm Whatman #1
Conditioning: none. Volume of sludge: ~ 202 ml.
Feed Solids: TSS(169380) Wgt of sludge — 225.41

Cake Analysis: Ident: 6(B-34) Tare: 102.43
Tare+Wet: 160.56
Tare+Dry 137.17
% Solids 59.8
Thickness 4to5 mm.

Filtrate Viscosity (100-M131) t = 63.4, t = 62.6 } 63.0 sec

t(min)	V(ml)	t(min)	V(ml)
0.3	26	4.5	148
0.6	44	5.0	156
1.0	61	5.5	162
1.3	72	6.0	165
1.6	81	6.57	166
2.0	92		1" pres. drop.
2.3	100		
2.6	108		
3.0	118		
3.5	127		
4.0	138		

22" Hg Specific Resistance

Date: Aug 14/80 — 9 cm Whatman #1

Conditioning: 1 lbs/ton PE 5/30 — Vol of sludge 200 ml

Feed Solids: (TSS) 169,380 — Wgt of sludge 212.05 gm

Cake Analysis: Ident: B-12.

Tare	110.10	
Tare + Wet:	151.68	
Tare + Dry:	133.62	
% Solids:	56.6	

$CST_{BEFORE\ POLY}$ 1) 16.5 2) 16.4 sec.

AFTER, 1) 5.8 2) 6.6 3) 6.4 AVER

Thickness: 3.5 to 4.0 mm

Filtrate Viscosity (no 100-M131) t = 61.3, t = 59.7 } 60.5 sec.

t (min)	V (ml)
.3	58
.5	74
.75	108
1.00	133
1.25	150
1.50	160
1.75	167
1.96	169

Note: 1 lb/ton caused granular flocs to form which settled but very rapidly causing a turbid supn to be present in the sample.
- settling began as soon as agitation ceased.

Note 2: 200 mls for Spec-Resist was difficult to sample because of rapid floc settling.

22" Hg Specific Resistance

Date: Aug 14/80. 9 cm Whatman #1
Conditioning: 0.5 lbs/ton PE5/30. Vol of sludge 200 ml
Feed Solids: TSS (169380) Wgt of sludge ?. gms

Cake Analysis: Ident B-33 Tare 103.41
Wet 159.31
Dry 136.04
% Solids 58.4 Thickness: 4.5 to 5.0 mm.

Filtrate Viscosity (no 100-M131) t = 61.5, t = 61.9 } 61.7 sec.

t(min)	V(ml)
0.3	32
0.6	51
0.8	60
1.0	69
1.25	78
1.50	86
1.75	94
2.0	102
2.25	108
2.50	116
3.0	126
3.5	138
4.0	149
4.5	158
5.0	163
5.34	165

– granular flocs, smaller than [illegible] lbs/ton) supn. – turbid (filtrate is clear)

CST on sludge after polymer – 13.4, – 13.6 } 13.5

Polymer : PE5/30

Concentration 0.1% - prepared Aug 14/80,

1.0 lb/ton = 83.9 mls/l

2.5 lb/ton = 209.9 mls/l.

5.0 lb/ton

7.5 lb/ton.

1.0 lbs/ton = ~~mg~~ gm of solids/l ÷ 2.

$= \frac{167.94}{2}$ = 83.9 mls/l (42 mls/500 mls)

2.5 lb/ton - 209.9 mls/l. (105 mls/500 mls)

Aug 14/80

8" Hg Specific Resistance

Wgt of sludge + cyl	467.98
Wgt of cylinder (final)	244.50
Wgt of sludge (gms)	223.48

15" Hg Specific Resistance

Wgt of sludge + cyl.	469.43
Wgt of cylinder (final)	244.61
Wgt of sludge.	224.82

22" Hg Specific Resistance

Wgt. of sludge + cyl.	468.95
Wgt of cylinder	244.45
Wgt of sludge	224.5

25" Hg Specific Resistance

Wgt of sludge + cyl.	469.95
Wgt of cyl.	244.54
Wgt of sludge.	225.41

Aug 14/80

22" Hg - 1.0 lb/ton - specific Resistance.

Wgt of sludge + cyl.	460.75.
Wgt of cyl.	248-70
Wgt of sludge (gms)	212.05

22" Hg - 0.5 lb/ton - Specific Resistance

Wgt of Sludge + cyl.	467.76
Wgt of cyl.	?
Wgt of sludge (gms)	

22" Hg - [illegible].0 lb/ton - Specific Resistance

Wgt of Sludge + cyl.
Wgt of cyl.
Wgt of sludge (gms).

Aug 15/80

Suspended Solids

Ident	Tare+dry	Tare	Volume	% Solids	$\bar{x}$
111	.9115	.0697	5.0	168360	
112	.9069	.0718	"	167020	167,530
113	.9070	.0709	"	167220	

Total Solids

Ident	Tare+Wet	Tare+Dry	Tare	% Solids	$\bar{x}$
66A	17.7379	3.9796	1.3556	16.0173	
67A	15.2175	3.5827	1.3585	16.0488	16.0599
68A	19.0400	4.2093	1.3605	16.1136	

Gravity Thickening Aug 15/80.

Initial Solids Total: 16.06%
Suspended: 167,530 mg/l ←

To get __ % solids, dilute y mls to 1000 mls with sludge overflow.

9	537
7	418
5	298
3	179
1	60

$\frac{9\%}{16.75\% \text{ (TSS)}} \times 1000 =$

537 ml × 167 mg/ml = 89,679 mg/l = 89.7 g
= 8.97%

Thickening Curves

HOURS	MIN	1%	3%	5%	7%	9%
0	0	1000	1000	1000	1000	1000
0	2	~25	880	930	970	990
0	5	58	675	800	910	960
0	12	58	270	545	775	888
0	20*	58	195	415	668	810
1	0 ǂ	~35	130	231	348	508
2	0 †	~35	105	188	282	375
3	0 ⊗	~35	98	168	258	344
5	0 ⊗	35	90	145	220	298
7	20 ⊗	35	88	135	195	258
20	30 a	~32	87	128	175	218
24	0	~32	86	128	173	215

Note: All supn at 2 min milky & turbid - greyish colour.

ǂ all supn very turbid

† supernatants clearing, but still turbid

⊗ higher % solids initially, have clearer supn ie 1% is still very turbid while 9% is only slightly turbid.

a = supr. clear, fines have formed a thin layer on the sludge - some solids are sticking to the sides of the cylinders.

After 24 hrs, some fines in suspension of all supernatants, greater in lower % solids.

Centrifuge Test Aug 15/80

HEIGHT OF CAKE 1) 23 mm CENTRATE VOL 1) 40.5 ml
2) 22.5 " 2) 40.5 ml
3) 22.5 "
4) 23 mm TSS = 167,530 mg/l

TOTAL SOLIDS ON CAKE

Ident	Tare + Wet	Tare + Dry	Tare	% SOLIDS	$\bar{x}$
69A	14.8035	9.1197	1.3572	57.73	57.75
70A	15.3574	9.4465	1.3623	57.76	

SCROLLED SOLIDS

Ident	Tare + Wet	Tare + dry	Tare	% Solids	$\bar{x}$
71A	10.0412	5.6320	1.3646	49.18	49.97
72A	10.3469	5.9202	1.3564	50.76	

SUSPENDED SOLIDS (after scroll)

Ident	Tare + dry	Tare	Volume	Solids	$\bar{x}$
114	.0722	.0712	10.0	100 ?	585
115	.0806	.0699	10.0	10701	

high variance

Centrifuge Notes.

NOTES: Centrals after spinning cloudy + turbid, visual solids (fine) in suspension still.

cake solids in centrifuge tube have a consistancy similar to clay - colour change apparent gray in round bottom, beige to last 2 mm which was red brown.

Freeze Thaw.

Date: Aug 15/80
Total Solids: 16.06%
Susp Solids: 167,530 mg/l.

CONTROL	Time	Volume	Total Volume
	9[17] AM 0	0	0
	3 min 15 sec → 1st drop.		
	10 min	30	30 mls
	30 "	50	80 "
	90 "	66	146 "
	3.0 HRS	64	210 "
	4.5 "	47	257 "
	7.0 "	21	278 "
	9.0 "	4	282 "
	22.5 "	5	287 "

Final cake height: ~18 mm

Cake Solids

Ident	Tare + Wet	Tare + Dry	Tare	% Solids
11 (B-22)	153.01	129.17	109.63	[45.04]

Frozen Sample

Freezing began at 9:30 AM Aug 15/80 FREEZER TEMP −16°C

Date	Time	Temp.
Aug 15, 9:30 AM	0	18.8°C
	20 min	+15.4°C
" 10:30	60 "	6.8°C
11:30	120 "	+.1°C
1 pm		−.1
4:15 "		−.8°C
7:00 "		−.8°C
Aug 16/ 7:30		− 15.4°C

Thawing

Date	Time	Temp.	
Aug 17/ 7:45		−15°C	out of freezer.
"	40 min	−1°C	
"	120 "	0°C	
	4 HRS	+.1°C	
	6 HRS	+.8°C	
	7 HRS	+1.0°C	
	9 HRS	+13.5°C	
Aug 18/80		20°C	

Cake Formation

Thawed sludge was poured on the sand at 9[30] AM on Aug 18/86.

Time	Volume	Total vol.
0	0	0
15 sec	1st drop	1 drop – very cloudy, like sludge prior to pouring.
1.5 min	33	33
10.0 "	38	71
60 "	87	158
120 "	82	240
160	48	288
280 "	4	292

Cake Solids

Ident	Tare + Wet	Tare + dry	Tare	% Solids
2(B-9)	146.05	127.81	109.47	50.14%

Notes - Freeze thaw

1) Control - very slow to filter through the sand bed. sludge formed a blanket on the sand + settled out leaving a layer of clear supn - over the sludge which had to filter through the sludge + the sand.

2) After thawing - sludge has settled to appx 100 mls in the plastic freezing container, it will be stirred + poured on the sand bed.

3) Sludge poured on sand after freezing was very slow to filter - the initial 35 mls (appr) was extremely high in solids. The sludge settled on the sand isolating a liquid layer over it.

Aug 15/80 Vacuum Filtration (Filter leaf) 22" Hg

Media: NY 527F
Cycle time: 3 min.
Feed Solids: (TSS) 167,530 mg/l

Form time: 58 sec
Dry time: 40 sec

Cake analysis

Ident: 8 (B-35)
Tare: 102.47
Tare + wet: 149.88
Tare + dry: 129.96
% solids: 57.98

Thickness: 2.5403 mm
Filtrate Vol: 300 mls

Filtrate Solids

Ident	Tare + dry	Tare	Vol.	% Solids	$\bar{x}$
116	.4846	.0713	5.0	82660	81,470 mg/l
117	.4734	.0720	"	80280	

% Recovery:
Yield:

Aug 15/80 Vacuum Filtration - 22" Hg

Media : NY529F
Cycle time : 3 min
Feed solids : (TSS) 167,530 mg/l

Form time : 58 sec
Dry time : 40 sec

Cake Analysis

Ident : 2(B-6)
Tare : 109.51
Tare + Wet : 158.23
Tare + dry : 138.37
% Solids : 59.24

Thickness : 2.5 to 3.0 mm
Filtrate Vol : 226

Filtrate Solids

Ident	Tare + dry	Tare	Vol.	% Solids	$\bar{x}$
118	.2105	.0707	5.0	27960	27940 mg/l
119	.2106	.0710	5.0	27920	

% Recovery :
Yield :

Vacuum Filtration - 22" Hg

Solids - Aug 16/80

Suspended Solids-

Ident	tare+dry	tare	volume	Solids	$\bar{x}$ mg/l
120	.9140	.0728	5.0 mls	168240	168,490 mg/l
121	.9120	.0715	"	168100	
122	.9171	.0714	"	169140	

Total Solids

Ident	tare+wet	tare+dry	tare	% solids	$\bar{x}$
73A	19.8838	4.3408	1.3593	16.0949	16.0948
74A	20.1310	4.3842	1.3582	16.1191	
75A	20.8588	4.4950	1.3617	16.0706	

Vacuum Filtration   Aug 16/80

Media : BPL 859   Form time - 58 sec
Cycle time : 3 min   dry time - 40 sec
Feed solids : 168,490 mg TSS/l

Cake Analysis   Ident : B-12
Tare : 110.11
Tare + wet : 152.50
Tare + dry : 134.72
% solids : 58.06

Thickness : 2.0 to 2.5 mm
Filtrate Vol : 254 ml

Filtrate Solids

Ident	Tare + dry	Tare	Volume	Solids	$\bar{x}$ mg/l
123	.4653	.0705	5.0	78960	79,150
124	.4673	.0706	5.0	79340	

% Recovery :
Yield :

Vacuum Filtration Aug 16/80

Media : POPR 853F
Cycle time : 3 min
Feed solids : 168,490

Form time : 58 sec
dry time : 40 sec

Cake Analysis

Ident,	6(B-34)
tare,	102.42
tare + wet,	149.21
tare + dry,	129.97
% solids,	58.88

Thickness : 2.0 to 2.5 mm
Filtrate vol : 188 mls
188

Filtrate solids

Ident	tare + dry	tare	volume	% solids	$\bar{x}$
125	.1532	.0708	5.0	16480	16,410 mg/l
126	.1523	.0706	5.0	16340	

Vacuum Filtration Aug 16/80

Media : POPR 851
Cycle time : 3 min
Feed solids : 168,490

Form time : 58 sec
dry time : 40 sec

Cake Analysis

Ident : B-33
tare : 103.40
tare + wet : 148.21
tare + dry : 129.74
% solids : 58.78

Thickness : 2.5 mm
Filtrate vol : 174

Filtrate solids

Ident	tare + dry	tare	volume	% solids	$\bar{x}$
127	.1097	.0703	10.0	3940	3925 mg/l
128	.1103	.0712	10.0	3910	

Vacuum Filtration   Aug 16/80

Media: POPR 851
Cycle time: 1 min
Feed solids 168,490

Form time: 19
dry time: 13

Cake Analysis
Ident: 2(B-31)
tare: 109.47
tare + wet: 135.95
tare + dry: 124.80
% solids: 57.89

Thickness: 1 mm.
Filtrate vol: 102 ml.

Filtrate solids

Ident	tare + dry	tare	volume	solids	$\bar{x}$
129	.1428	.0698	10.0	7300	7270 mg/l.
130	.1434	.0710	10.0	7240	

% Recovery:
Yield:

Vacuum Filtration

Aug 16/80

Media: POPR 851
Cycle time: 5 min.
Feed solids 168,490

Form time: 96
dry time: 67

Cake Analysis

Ident: 9(B-15)
tare: 103.38
tare + wet: 163.04
tare + dry: 138.81
% solids:

Thickness: 3.5 mm.
Filtrate vol: 237 ml

Filtrate solids

Ident	tare + dry	tare	volume	solids	$\bar{x}$
130	.1172	.0703	20	2345	2310 mg/l
132	.1165	.0702	"	2315	

% Recovery:
Yield:

Aug 16/80

Solids

Suspended

Ident	tare + dry	tare	volume	Solids	$\bar{x}$
133	.9202	.0711	5.0	169820	169,980
134	.9236	.0691	"	170900	
135	.9171	.0710	"	169220	

Total

Ident	tare + wet	tare + dry	tare	% solids	$\bar{x}$
76A	19.2632	4.2514	1.3612	16.1446	16.1638 %
77A	19.5484	4.3047	1.3639	16.1720	
78A	19.7281	4.3353	1.3651	16.1749	

Floc Strength

Filter media : POPR 851
Conditioning : sheared
Feed solids : 169,980 mg/l

Form time : 58 sec
dry time : 40 sec.
cycle time : 3 min

Cake Analysis : Ident : 75.
tare : 102.50
tare + wet : 149.81
tare + dry : 130.23
% solids : 58.61

Thickness : 2 to 2.5 mm.
Filtrate vol : 179 ml

Filtrate Analysis.

Ident	tare + dry	tare	volume	solids	$\bar{x}$
136	.1243	.0702	10.0	5410	5405 mg/l
137	.1241	.0701	"	5400	

% Recovery
Yield.

Aug 16/80 Floc strength - Buchner Funnel

Conditioning - sheared

25" Hg - Whatman #1
Appr vol of sludge - 200 ml

Wgt of sludge + graduate	:	467.38
Wgt of graduate	:	244.25
Wgt of sludge	:	223.13

<u>Cake Analysis</u>

Ident : 7 (B-31)
tare : 109.84
Tare + wet : 168.12
Tare + dry : 144.68 Cake thickness: .5 cm
% solids : 59.78

Filtrate Viscosity : (100-M131) t = 61.6, t = 62.0 } 61.8 sec.

t (min)	V (ml)		
.3	24	3.5	127
.6	42	4.0	137
1.00	59	4.5	147
1.3	70	5.0	155
1.6	80	5.5	160
2.0	91	6.0	163.5
2.3	99	6.15	164
2.6	106		1 drop
3.0	116		

Aug 16/80

C.S.T - before shearing

1) 21.3
2) 22.7
3) 23.9

} 22.6 sec

CST - after shearing.

1) 22.5
2) 21.9
3) 22.0

} 22.1 sec.

Aug 17/80

Filter media - NY 527F Conditioning - none.
Pressure - 75 PSIG. - same feed solids as Aug 16.

Time (min)	Vol. (ml)	Total Vol (ml)	
0	25	25	- very turbid
.54	100	100	- very high in solids
.8	58	158	first 160 mls looks like feed.
1.2	86	186	
2.0	125	225	
3.5	180	280	
5.0	221	321	
6.24	250	350	- filtrate still very cloudy + turbid.
7.5	26	376	
11.00	90	440	
16.00	164	514	
20.00	214	564	
23.30	250	600	
27.50	34	634	
30.00	72	672	
30.66	160	760	- violent surge at end blew sludge + filtrate on floor + all inside of fume hood!

Filtrate Solids - first 100 mls:

Ident	tare + dry	tare	volume	Solids
138	.6075	.0701	5.0	107,480 mg/l

Remainder:

Ident	tare + dry	tare	volume	Solids
139	.1738	.0702	10.0	10,360 mg/l

Cake Solids

Ident: 8 (B-35)
tare: 102.47
tare + wet: 357.89
tare + dry: 252.18
% solids: 58.61
Thickness: ~3" to 3.5 cm.

cake - pasty on top (like thin custard) + a hole was present along one side of the cake where the liquid had pushed through.

Pressure Filtration

Aug 17/80

Filter media: NY529B   Conditioning - none
Pressure : 75 pSIG

Time(min)	Vol (ml)	Total Vol(ml)	
0	10	10	cloudy, not near as bad as previous run
.35	50	50	
.96	100	100	
2.5	65	165	clear,
5.0	150	250	
7.5	205	305	
10.00	250	350	
[illegible]00	79	429	
17.50	113	463	
20.00	143	493	
[illegible]5.00	197	547	slight carryover.
30.42	250	600.	
[illegible]3.90	130	730 ⇒ FINISH	

Filtrate Solids - first 100 mls

Ident	tare + dry	tare	volume	solids
140	.2536	.0702	100	1834 mg/l

Remainder

141	.3074	.0696	250	951 mg/l

Cake Solids:

Ident : 2(B-9)
Tare : 109.48
Tare + wet : 388.94
Tare + dry : 274.13
% solids 58.92 % ←
THICKNESS 3.5 cm

Pressure Filter

Aug 17/80

Filter Media : PoPR 851 conditioning: none
Pressure : 75 psig

Time (min)	Vol (ml)	Total vol. (ml)	
0	10	10	} cloudy, turbid, high in solids
.6	77	77	
.84	100	100	
2.0	53	153	– cloudy, turbid.
4.5	136	236	↓ decreasing turbidity & solids
7.5	210	310	
9.68	250	350	
15.00	87	437	↓ clear
20.00	148	498	
25.00	205	555	
29.63	250	600	
31.60	13	613	
32.00	36	636	
32.75	108	708	very turbid / not violent
33.5	173	773	
34.3	198	798	– breakthrough.

Filtrate solids, - First 100 mls

Ident	tare + dry	tare	volume	solids (mg/l)
142	.2625	.0697	10.0	19280

Remainder

143	.1238	.0707	250.0	212 mg/l

Cake Analysis:

Ident: 9 (B-15)
tare: 103.38
tare + wet: 250.94
tare + dry: 189.95
% solids: 58.67 %
thickness: 3.5 cm.

Aug 17/80 - Solids

Suspended-

Ident	tare + dry	tare	volume	solids	$\bar{x}$
144	.9033	.0708	5.0	166500*	* OMIT.
145	.9247	.0695	"	171040	170,820 mg/l
146	.9231	.0701	"	170,600	

* sample spilt in dry oven from vibration

Total

Ident	tare + wet	tare + dry	tare	% solids	$\bar{x}$
79A	22.0196	4.7287	1.3653	16.2843	16.2903
80A	20.4039	4.4701	1.3682	16.2952	
81A	20.6620	4.5101	1.3666	16.2914	

Pressure Filter

Aug 17/80

Filter Media : POPR 853F
Pressure : 75 psig.

conditioning — none.
— new solids

Time (min)	Vol (ml)	Total Vol (ml)	
0	~ 8	8	
.25	45	45	
.88	100	100	
2.00	51	151	↓ crystal clear no colour.
5.0	148	248	
7.5	202	302	
10.19	50	350	
16.00	88	438	
20.00	138	488	
25.00	193	543	
30.96	250	600	
34.0	34	634	
35.0	49	649	
37.5	89	689	
40.0	128	728	
41.4	150	750	
42	159	759	
43.6	176	776	
43.71	206	806	— small surge of fines

Filtrate Analysis - First 100 mls.

Ident	tare+dry	tare	volume	% solids
147	.0873	.0692	20	905 mg/l

Remainder

148	.0892	.0705	500	37 mg/l

Cake Analysis: Ident: B-12
tare: 110.10
tare+wet: 255.46
tare+dry: 196.03
% solids: 59.12 ←
~~thickness.~~ 3.5 cm

Pressure Filter Aug /80

Filter Media : POPR 851 Conditioning - none
Pressure : 75 pSIG

Time (min)	Vol (ml)	Total Vol (ml)	
0	~5	5	cloudy
.25	34	34	
.95	100	100	
4.0	119	219	crystal clear
6.0	169	269	
7.5	203	303	
9.94	250	350	
16.50	98	448	
20.00	144	494	
25.00	197	547	
30.42	250	600	
35.00	46	646	cloudy
37.00	92	692	
40.00	182	782	
40.47	206	806	- last bit quite cloudy

Filtrate solids - first 100 mls.

Ident	tare + dry	tare	volume	% solids.
149	.0910	.0710	100	200 mg/l

Remainder.

150	.0826	.0707	500.	24 mg/l.

<u>Cake Analysis</u>: Ident: 11 (B-22)
tare: 109.63
tare + wet: 246.14
tare + dry: 190.71
% solids 59.40
thickness: 3.6 mm.

Pressure Filter Aug '80

Filter Media: POPR 851 conditioning - none
Pressure : 50 psig

Time (min)	Vol (ml)	Total vol (ml)	
0	~5	~5	
.5	63	63	
1.08	100	100	crystal clear (1.08–55.00)
3.00	70	170	
6.00	144	244	
12.30	250	350	
15.00	34	384	
20.00	90	440	
25.00	139	489	
30.00	183	533	
35.00	223	573	
47.50	97	697	
52.50	158	758	
55.00	193	793	
55.25	209	809	← slight solids carryover

Filtrate solids - first 100 mls.

Ident	tare + dry	tare	volume	solids (mg/l)
151	.0912	.0704	100	208 mg/l

Remainder:

152	.0748	.0693	500	11 mg/l

Cake Analysis: Ident: B-33
tare: 103.42
tare + wet: 250.83
tare + dry: 187.84
% solids: 57.27 ←
~~thickness~~: 3.6 to 3.7 cm.

Pressure Filter Aug 17/80

Filter media: CANVAS conditioning - none -
Pressure : 75 psig

Time (min)	Vol (ml)	Total vol (ml)
0	0	0
.4	62	62
.85	100	100
2.00	60	160
6.00	184	284
9.04	250	350
15.00	100	450
20.00	166	516
25.00	223	573
27.68	250	600
32.50	53	653
37.50	127	727
39.00	150	750
40.00	165	765
42.00	196	796
42.88	219	819

(0 – .85 min) slightly cloudy, clear·d (arrow to 2.00 – 40.00 min)

(42.88 min) - no solids carryover, crystal clear

Filtrate Solids - first 100 mls

Ident	tare + dry	tare	volume	solids (mg/l)
153	.0935	.0691	100	244 mg/l.

Remainder:

Ident	tare + dry	tare	volume	solids (mg/l)
154	.0716	.0710	500	1.2 mg/l

Cake Solids:

Ident:	75
tare:	102.51
tare + wet:	240.02
tare + dry:	184.87
% solids:	59.89
~~thickness~~:	3.5 cm

Aug 18/80 -

The Madawaska Sludge was a greyish beige sludge which gravity thickens to in excess of 30% solids.

The sludge is composed of fine particles which are very dense & which compact on settling (ie sludge thickness is reduced)

During the resistivities, filtering was moderately fast as were the pressure filter run. The cake from the pressure filter was always wet on top (like paste or pudding)

The filter leaf cake was always wet at the sludge/media interface -

The sludge seems relatively unaffected by shearing or freezing.

Initially, appr. 5 gal of sludge was mixed with appr 8 gal of supernatant to get a working soln of 16% solids. (The sludge had settled in the 5 gal container prior to mixing)

POOR

QUALITY

ORIGINAL